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U. S. DEPARTMENT OF AGRICULTURE.

FARMERS' BULLETIN No. 37.

KAFIR CORN:

CHARACTERISTICS, CULTURE, AND USES.

BY

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U. S. DEPARTMENT OF AGRICULTURE,
OFFICE OF EXPERIMENT STATIONS,
Washington, D. C., April 15, 1896.

SIR: I have the honor to transmit herewith, and to recommend for publication as a Farmers' Bulletin of this Department, an article on Kafir corn, prepared by C. C. Georgeson, professor of agriculture in the Kansas State Agricultural College, and agriculturist of the Kansas Experiment Station.

Kafir corn, which was introduced into this country by the Department of Agriculture, has recently come into prominence as a forage plant peculiarly adapted to the semiarid portions of the United States, where Indian corn frequently fails, and promises to be of great value to these regions.

Respectfully,

A. C. TRUE,
Director.

Hon. J. STERLING MORTON,
Secretary of Agriculture.

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KAFIR CORN.

(*Andropogon sorghum vulgaris.*)

CHARACTERISTICS, CULTURE, AND USES.

Kafir corn is a native of South Africa, and takes its name from the African tribe known as Kafirs. It belongs to the same group of plants as broom corn and other nonsaccharine sorghums. It was introduced some ten years ago by the United States Department of Agriculture and distributed all over the country. It was first sent to the Southern States, where it did well, and the following year it was distributed in the North also. The reports from these trials were generally favorable. In California it was highly appreciated, and soon became a favorite food for chickens. The farmers of Kansas and Oklahoma have given it much attention during the three or four years past and, finding it a valuable stock food, are cultivating it on a large and ever-increasing scale. Its drought-resisting qualities have recommended it especially to farmers living in localities too dry for the best development of corn.

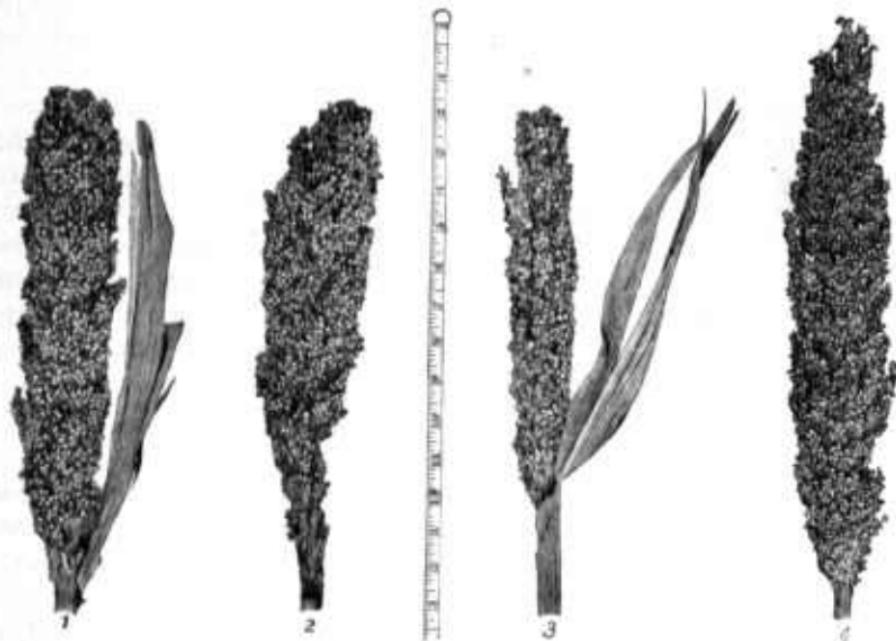
VARIETIES.

There is at present a lamentable confusion in the names of the so-called nonsaccharine varieties of sorghum, and it is difficult to determine how many should be classed as Kafir corn. The Kansas Experiment Station grew nearly a hundred kinds of these sorghums in 1891 and 1892, the seed of which had been collected by United States consuls at points in Africa, India, and China. Most of them failed to mature seed, but of those which succeeded several would answer the description of Kafir corn. At present there are at least three varieties popularly called Kafir corn. They may be described as follows:

Red Kafir corn.—Plant from 4 to 6 feet tall, according to soil, season, and culture. Stalk close-jointed, producing 9 to 14 leaves. Leaves thick, somewhat rough, and stiffer than corn leaves. The plant rarely suckers, but it will occasionally throw out branches from the upper joints. The sheaths are quite generally colored red or purple in patches and spots, due to a blight. Head upright, long, and narrow, always pushing clear of the sheath of the upper leaf; spikelets short, compact, and held close to the head. Seed red or light brown, small, almost round, brittle, starchy, and packed so closely in the head that the stems and hulls are scarcely visible. Hulls (glumes) small, thin, brown, covering less than half of each seed.

White Kafir corn.—Like the red variety, the plant is short-jointed and has an abundance of foliage, but does not grow quite so tall. The head is upright, slender, compact, but frequently fails to shoot out of the enveloping sheath, the portion remaining covered being worthless, as it either fails to form seed or the seed formed molds and spoils. The seed is white, slightly flattened sidewise, starchy, and pleasant to the taste. The hulls are gray or greenish white, hairy, somewhat larger and more conspicuous than those of the red variety. The ripe seed shells out readily in handling.

Black-hulled white Kafir corn (African millet).—Plant like the foregoing. Head upright, rather shorter, broader, and looser than that of



Heads of Kafir corn, from a photograph of specimens grown in Kansas and Oklahoma.

- Nos. 1 and 2. Black-hulled white Kafir corn (African millet).
- No. 3. White Kafir corn.
- No. 4. Red Kafir corn.

the red sort; sometimes narrow below and broad above, making it somewhat club-shaped. This is due to the fact that the spikelets are longer than those on the white variety, with a tendency to spread. Seed white, many grains having a reddish or brown spot, somewhat larger than the red. Hulls gray, brown, or black, hairy, larger than the hulls on the red sort. The head shoots clear of the enveloping sheath. The cut illustrates this variety as grown in a field. The variety goes by the three names of Black-hulled white Kafir corn, White Kafir corn, and African millet.

The red and white varieties have been grown at the Kansas station for several years, with the following results: Under the same conditions

the red variety has invariably outyielded the white, both in grain and fodder; it grows some 6 to 9 inches taller; it matures its seed a little earlier, and the head always pushes clear of the upper sheath; it does not shell in handling, and has a more succulent stalk. On the other hand, the white variety has a pleasanter taste and produces grain which is not at all astringent, and is therefore better relished by stock.

The Black-hulled white Kafir corn has only been grown here the past season, but it appears to have all the good qualities of the red variety, and has in addition a white seed. The seed coat also is nonastringent, a characteristic of all white seed of the sorghum tribe. If further tests show that the black-hulled white variety yields as well as the red, it will undoubtedly take the lead.

There appears to be a strong tendency to variation in this group of sorghums. With skillful selection and breeding, varieties could doubtless be developed superior to any now known. Great care in the selection of seed and to prevent crossing with other sorghums is necessary in order to prevent deterioration.

SOILS AND CLIMATE ADAPTED TO KAFIR CORN.

Like all other crops, Kafir corn yields best on rich land. It responds well to generous treatment. Its culture, however, is not limited to soils of certain classes and qualities. It may be grown on stiff clays and on light sand, in river bottoms and on poor uplands, and it will yield profitable returns on soil too poor for corn.

Perhaps the strongest recommendation of Kafir corn lies in the fact that it will produce a crop on less rain than is required for corn, and that it is not affected so disastrously by hot winds. It is, therefore, especially adapted to the semiarid West, where corn succeeds only once in five or six years because of hot winds and drought. It is owing chiefly to this quality that its culture has spread so rapidly in Kansas and Oklahoma. Hot winds are the main cause of the failure of the corn crop in this region, and they are never more destructive than when they happen to come when the corn is tasseling. They cause the pollen to dry up, and the silk is not fertilized. Even with a sufficient rainfall, a few days of these withering blasts from the southwest, in tasseling time, may reduce the yield of corn 50 per cent. Kafir corn is not affected in the same way. Fertilization takes place more readily and the whole plant is better adapted to stand dry weather. The leaves are thicker and coarser than corn leaves, and do not dry out so readily; they are closer together and partly protect each other, and the plant is not so tall and, therefore, not so much exposed. When corn has once been stunted by drought or hot winds, it never recovers. Not so with Kafir corn. It may remain stationary and curled for days and even weeks, but when the hot winds cease and rain comes it will revive and, if not too late in the season, will still produce a crop of grain.

While it can be grown to perfection in southern and middle latitudes, the northern limit of its successful culture is as yet not well defined.

In tests at the Ontario Agricultural College, the season appeared to be too short for the grain to mature. Henry does not consider it suited to Wisconsin. The Michigan station regards it as inferior to corn for forage. Possibly further trials may cause a revision of these opinions, but it will, nevertheless, be wisest for the farmers in the northern tier of States to grow it at first only on a small scale.

PREPARATION OF THE SOIL.

The soil should be prepared as for corn. Plow and harrow to bring the soil to a fine tilth. If it has been subsoiled the previous fall, all the better. If the surface is rough, it should be worked with a pulverizer till redneed. An even, mellow surface facilitates cultivation. The young plants are feeble and of slow growth during the first six weeks, and a rough, uneven surface can not be worked without covering them up.

Seeding takes place, according to the latitude, from the middle of March in the South to the beginning of June in the North. At the Kansas station the seed is usually put in the ground about the middle of May. There is nothing gained by seeding before the soil is warm. A good rule to follow is to seed as soon as corn planting is finished.

METHODS OF SEEDING.

Kafir corn can be grown either in hills or in drills, but the latter is considered preferable. The rows should be from 2.5 feet to 3.5 feet apart. The stalks will vary in height from 4 feet to 6.5 feet, according to richness of soil and thickness of stand, the richer soil producing the heavier growth and therefore requiring the wider rows. It may be seeded with a corn planter fitted with sorghum or broom-corn plates. At the Kansas station a shoe grain drill with press wheels and force feed is generally used. The shoes are 8 inches apart; therefore, by leaving the first and fourth feeds open and covering up all the others, the rows are sown 32 inches apart. It requires about 6 pounds to seed an acre. A little practice on bare, hard ground where the seed can be seen will soon show how the feed bar should be set to discharge the right amount. It is better that the stand should be a little too thick than not thick enough. For a maximum crop of grain on soil of moderate fertility, the plants should stand from 4 to 6 inches apart in the row, and on rich soil 9 inches. If a maximum crop of fodder is wanted in addition to a good yield of grain, put in 10 to 12 pounds of seed to the acre.

Kafir corn is sometimes sown for hay, that is, it is sown thick, either with a drill, or broadcast, and the crop, when headed, cut with a mower and treated as a hay crop. If cut early, it may produce two crops. Some variety of sweet sorghum, however, is better suited for hay. In the middle West the Kansas Orange is a good variety, and in the north the Early Amber.

Listing Kafir eorn, as eorn is listed, is not recommended. The plants are spindling and of slow growth during the first few weeks, and if a heavy rain should fall during that time it would either wash the soil into the furrows and bury the plants or the furrows would serve as drains, with the result that the crop would be washed out. There is another objection to listing. On account of the slow growth of the plants, the weeds soon get the start of them, and it is practically impossible to cultivate without covering the plants. If listing is practiced at all, the furrows should be very shallow.

CULTIVATION.

The crop should be cultivated like sorghum or eorn. The weeds should be kept down from the start, using preferably a spring-toothed cultivator, which will not throw the earth muelh, with fenders attached while the plants are small to prevent covering them up.

The roots are near the surface. Investigations at the Kansas station last summer showed that the roots reach out 4 to 6 feet laterally in all directions and that most of them are from 2 to 6 inches from the surface. Deep culture is, therefore, a mistake, since it destroys a large portion of the feeders and to that extent weakens the plants. The surface soil should be kept mellow until the crop begins to head, when cultivation should cease. If seeded about the middle of May, the plants will head early in August and the grain will be ripe about the middle of September.

HARVESTING.

The crop should be cut and shocked as soon as the grain is ripe. English sparrows will damage it badly if they have the chance. Over-ripeness also causes the white Kafir corn to shell when handled. Unlike eorn, all varieties have the very desirable quality of remaining green, after the grain matures, until killed by frost. The fodder is, therefore, still in excellent condition when the grain ripens, and when cured will make better feed than if the plant had dried up as the corn plant does.

The crop can be harvested in several ways. At the Kansas station it is usually cut with a sled cutter, which takes two rows at a time. The cutter is pulled by one horse and requires two attendants, one to care for each row. The crop is collected in armfuls as cut, and shocked. Any good eorneutter will do the work. It can, of course, also be cut by hand if a machine is not available. A light, short crop may even be cut with a self-binder. Some growers use a header, collecting the heads only and leaving the fodder to be eaten off by stock. The header will cut off a large per cent of green leaves with the heads, which renders the curing of the latter, preparatory to the thrashing, more difficult. In that case, it is best to pile them with layers of dry straw to prevent heating.

When the heads are cured and ready to thrash, there are again several modes of procedure. The most common way is to cut the heads off with a corn knife. A large armful is laid with the heads across a block of wood, when a few strokes sever them. It may be thrashed without severing the heads, either by running the whole plant through the thrasher—which, however, is not desirable, as it breaks the leaves up very badly—or by sticking the heads of an armful of plants into the cylinder for an instant until the grain is beaten out.

Still other growers cut the heads off one by one in the field and throw them in a wagon, as they would gather corn that has not been cut. This, however, would seem to be too slow a process to suit many people.

Lastly, many farmers do not thrash the grain at all, but feed the stalk, head and all, as cut. But even though it is fed in tight boxes, so that waste by shattering is largely prevented, there is, nevertheless, a large waste in feeding the seed whole, since it is not masticated and goes through the animals undigested.

Heads which are not perfectly dry should not be thrown in large piles, as they will heat. They can be stored in narrow cornerbins or in narrow rail pens, built so as to let the air pass through the mass.

In thrashing, the grain, especially of the red variety, will break badly unless the concave is removed from the machine and boards put in its place.

YIELD OF KAFIR CORN.

The yield per acre of grain and fodder must, of course, vary with the season. The red variety, as grown at the Kansas station, has invariably outyielded both white Kafir corn and Indian corn. The average yields per acre of these three at this station for the years 1889, 1890, 1891, and 1892 were as follows:

Yields of red and white Kafir corn and of Indian corn.

Variety.	Grain.		Fodder.
	Bushels.	Tons.	
Red Kafir corn.....	58.25	6.05	
White Kafir corn.....	32.55	5.33	
Indian corn.....	45.50	3.07	

The grain yields refer to clean seed, 56 pounds to the bushel, and the fodder yields to the field-cured weight. In 1893 the white variety was discarded as being too light a yielder. In that year the red Kafir corn yielded 49 bushels of seed and 5.25 tons of fodder, while corn yielded 30 bushels of seed and 1.75 tons of fodder. In the extremely dry season of 1894 even the red variety failed to produce more than a light sprinkling of seed, scattered over the field, and it was not thrashed; but the fodder averaged 2 tons per acre. In 1895, 15 acres of the red Kafir corn averaged 41 bushels of grain and 2 tons of fodder per acre. Black-hulled white Kafir corn (grown at the Kansas station for the first time in 1895)

yielded in plats at the rate of 34.03 bushels of grain and 1.23 tons of fodder per aere, and corn produced 23.05 bushels per acre. In 1891 the red variety produced the highest yield on record here, viz, 98 bushels per acre. The same year the Nebraska station reports a yield of 112.5 bushels of grain per acre, variety not named. At the North Louisiana station, in 1893 Kafir corn produced 4 tons of fodder and 10 bushels of grain per aere. In the same year, at the Arkansas station, it produced 5,178 pounds of dry fodder per acre.

COMPOSITION OF KAFIR CORN.

The chemical composition of Kafir corn has not been very thoroughly studied. No analyses with reference to fertilizing constituents are available. Analyses with reference to food constituents are collected in the following table, which also includes for comparative purposes similar data for Indian corn.

These analyses show that Kafir corn compares favorably with corn in the amount of nutrient it contains, although slightly poorer, as a rule, in the more valuable food constituents—protein and fat.

Food constituents in Kafir corn and Indian corn.

	In fresh or air-dry material.						Authority.
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.	
	Percent.	Percent.	Percent.	Percent.	Percent.	Percent.	
Kafir corn (whole plant, green).	76.13	1.75	3.22	6.16	11.96	0.78	Pennsylvania station.
Do	76.05	1.44	2.34	8.36	11.41	0.40	New York Cornell station.
Average	76.09	1.60	2.78	7.26	11.69	0.59	
Corn (whole plant, green)	79.30	1.20	1.80	5.00	12.20	0.50	
Kafir corn fodder (whole plant).	10.94	5.48	3.31	30.37	47.40	2.50	North Carolina station.
Corn fodder (whole plant)	11.00	4.16	6.93	22.02	53.43	2.46	
Kafir corn fodder (without heads).	8.67	7.14	4.89	28.02	49.75	1.53	Kansas station.
Corn stover (without ears).	29.00	5.20	5.81	30.12	48.19	1.68	
Kafir corn (mature head)	16.23	2.02	6.92	6.79	65.18	2.86	North Carolina station.
Corn ears (corn-and-cob meal).	15.10	1.50	8.50	6.60	64.80	3.50	
Kafir corn seed	9.31	1.53	9.92	1.35	74.92	2.97	Kansas station.
Corn kernels	10.90	1.50	10.50	2.10	69.60	5.40	
Kafir corn flour	16.75	2.18	6.62	1.16	69.47	3.82	North Carolina station.
Corn meal	15.00	1.40	9.20	1.90	68.70	3.80	

¹ Assumed: Field-cured corn fodder contains on an average 42.2 per cent of water.

² Assumed: Field-cured corn stover contains on an average 40.5 per cent of water.

PRACTICAL FEEDING TESTS.

The feeding value of Kafir corn has not been fully worked out. So far as the writer is aware, the Kansas station is the only one which has as yet undertaken feeding experiments with this crop, and these have been confined to the grain of the red variety. The results are summarized below.

During the winter of 1894-95 three lots of hogs, which averaged at the beginning of the experiment about 150 pounds a head, were fed (1) Kafir corn meal, (2) corn meal, and (3) ground wheat, with a view to compare the value of these three feeds.¹ All feeds were stirred in enough water to make a thick slop. The experiment continued for 77 days. At the end of that time the Kafir corn lot had eaten an average of 545 pounds per head and gained 106 pounds per head. This means a consumption of 5.15 pounds of feed for each pound of pork made. The corn meal lot had eaten 573 pounds of feed per head, on which each had made a gain of 131 pounds; or, it had taken 4.38 pounds of feed to produce a pound of gain. The ground wheat lot had eaten 564 pounds of feed per head and gained 137 pounds, which is equal to a consumption of 4.11 pounds of feed for each pound of gain. In other words, 100 pounds of corn produced as much gain as 117.64 pounds of Kafir corn. This is not a flattering showing for the Kafir corn.

This station has just concluded another experiment in the same line, with the following results: Four lots of three pigs each were fed for the same period as above, 77 days, on (1) Kafir corn meal, (2) a mixture of one-third soja bean meal and two-thirds Kafir corn meal, (3) corn meal, and (4) a mixture of one-third soja bean meal and two-thirds corn meal, with gains as shown in the following table:

Gains by hogs fed Kafir corn, in comparison with other foods.

	Lot 1, Kafir corn meal.	Lot 2, Kafir corn meal and soja bean meal.	Lot 3, corn meal.	Lot 4, corn meal and soja bean meal.
Gain of lot, 77 days.....	Pounds. 110.50	Pounds. 380.00	Pounds. 184.00	Pounds. 384.50
Daily gain per pig.....	0.47	1.64	0.79	1.65
Food eaten per pound of gain.....	6.48	3.51	4.88	3.23

Here, again, the Kafir corn fell much behind the corn when both were fed alone, but when mixed with a highly nutritious substance, like soja bean meal, the growth obtained was but slightly behind that of a similar mixture with corn as a basis. It should be stated that in this case the pigs were even smaller than in the former trial. They averaged only 63 pounds each at the beginning of the experiment.

The same station has also made an experiment with Kafir corn as feed for cattle. Three pure-bred Aberdeen-Angus heifers, which were to be fed for the butcher, were tied up in the stable and fed, one on Kafir corn meal and eat corn stover and two on corn meal and eat corn stover. The gains of both lots were small, from the fact that they were almost fat when tied up.

During the first six weeks 1 pound of live weight was gained on 15.46 pounds Kafir corn meal and 1.65 pounds corn fodder for the heifer fed this ration; and 1 pound of gain was made on 18.47 pounds of corn

meal and 2.4 pounds of corn fodder, this being the average of the two in the corn meal lot. Here the Kafir corn made decidedly the best gain. It was apparent, however, that they could not be fattened satisfactorily on these rations. The corn fodder was, therefore, changed to alfalfa, and oil meal was added to the grain ration in the same proportion for both lots, and with this change the experiment went on for six weeks longer. The results for the whole period of twelve weeks stand as follows: The heifer on Kafir corn had eaten during this time 11 pounds of Kafir corn meal, 0.54 pound of oil meal, 0.68 pound of corn fodder, and 1.21 pounds of alfalfa for each pound of gain she made, or a total of 13.43 pounds of food for each pound of gain. The average amount eaten by the two on corn meal ration for each pound of gain was 9.77 pounds of corn meal, 0.63 pound of oil meal, 0.65 pound of corn fodder, and 1.26 pounds of alfalfa, a total of 12.31 pounds of food for a pound of gain. It should be noticed that this lot ate 0.09 pound of oil meal and 0.05 pound of alfalfa for each pound of gain more than the Kafir corn lot. The total amount of Kafir corn meal eaten was 1,199.28 pounds. The gain was 109 pounds. The average amount of corn meal eaten per head was 1,422.35 pounds, the average gain being 145.5 pounds.

As to the value of Kafir corn as feed for horses and mules, Capt. H. L. Scott, of Fort Sill, writes under date of March 17, 1896, that two 6-mule teams (one young mules and the other old) used continually for freighting on the road, and twelve horses, six in each of two cavalry troops, were fed exclusively on black-hulled white Kafir corn and hay for one month "with excellent results."

Many farmers in Kansas and Oklahoma report that they have grown and fed Kafir corn with gratifying success. The experiments thus far made, however, do not justify the statement sometimes made that the grain is equal to corn as a food. It should be ground before it is fed. For hogs it is best to make the meal into a slop, but it should be fed dry to horses and cattle. The fodder has not yet been experimentally studied, but cattle, horses, and sheep eat it with relish and do well on it.

The grain has been recommended as an article of human food and several mills in Kansas have put in special machinery for grinding it. Those who have tried the flour assert that good bread and excellent cakes can be made from it. The analysis in the table on page 9 indicates that this product is similar to corn meal in composition but is somewhat deficient in protein.

FARMERS' BULLETINS.

These bulletins are sent free of charge to any address upon application to the Secretary of Agriculture, Washington, D. C.

[Only the bulletins named below are available for distribution.]

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- No. 34. Meats: Composition and Cooking. Pp. 29.
- No. 35. Potato Culture. Pp. 23.
- No. 36. Cotton Seed and Its Products. Pp. 16.
- No. 37. Kafir Corn: Characteristics, Culture, and Uses. Pp. 12.
- No. 38. Spraying for Fruit Diseases. Pp. 12.
- No. 39. Onion Culture. Pp. 31.
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- No. 48. The Manuring of Cotton. Pp. 16.
- No. 49. Sheep Feeding. Pp. 24.
- No. 50. Sorghum as a Forage Crop. Pp. 24.
- No. 51. Standard Varieties of Chickens. Pp. 48.
- No. 52. The Sugar Beet. Pp. 48.
- No. 53. How to Grow Mushrooms. Pp. 20.
- No. 54. Some Common Birds in Their Relation to Agriculture. Pp. 40.
- No. 55. The Dairy Herd: Its Formation and Management. Pp. 24.
- No. 56. Experiment Station Work—I. Pp. 30.
- No. 57. Butter Making on the Farm. Pp. 15.